

## 5.0 Allocation

For the Broad Run, Kettle Run, South Run, Popes Head Creek, Little Bull Run, Bull Run and the Occoquan River TMDLs, allocation analysis was the third stage in development. Its purpose was to develop the framework for reducing bacteria loading under the existing watershed conditions so water quality standards can be met. The TMDL represents the maximum amount of pollutant that the stream can receive without exceeding the water quality standard. The load allocations for the selected scenarios were calculated using the following equation:

$$\text{TMDL} = \sum \text{WLA} + \sum \text{LA} + \text{MOS}$$

Where,

WLA = wasteload allocation (point source contributions);

LA = load allocation (non-point source allocation); and

MOS = margin of safety.

Typically, several potential allocation strategies would achieve the TMDL endpoint and water quality standards. Available control options depend on the number, location, and character of pollutant sources.

### 5.1 ***Incorporation of Margin of Safety***

The margin of safety (MOS) is a required component of the TMDL to account for any lack of knowledge concerning the relationship between effluent limitations and water quality. According to EPA guidance (*Guidance for Water Quality-Based Decisions: The TMDL Process, 1991*), the MOS can be incorporated into the TMDL using two methods:

- Implicitly incorporating the MOS using conservative model assumptions to develop allocations; or
- Explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations.

The MOS will be implicitly incorporated into this TMDL. Implicitly incorporating the MOS will require that allocation scenarios be designed to meet the monthly fecal *coliform* geometric mean standard of 200 cfu/100 ml and the instantaneous fecal *coliform* standard of 400 cfu/100 ml with 0% exceedance. In terms of *E. coli*, incorporating an implicit MOS will require that the allocation scenario be designed to meet the monthly geometric mean standard of 126 cfu/100 ml and the instantaneous standard of 235 cfu/100 ml with 0 violations.

## 5.2 Sensitivity Analysis

The sensitivity analysis of the fecal *coliform* loadings and the waterbody response provides a better understanding of the watershed conditions that lead to the water quality standard violations, and provides insight and direction in developing the TMDL allocations and implementation. Based on the sensitivity analysis, several allocation scenarios were developed. For each scenario developed, the percent of days water quality conditions violate the monthly geometric mean standard and instantaneous standard for *E. coli* were calculated. The results of the sensitivity analysis are presented in Appendix F.

## 5.3 Allocation Scenario Development

Allocation scenarios were modeled using the calibrated HSPF model to adjust the existing conditions until the water quality standard was attained. The TMDLs developed for the Broad Run, Kettle Run, South Run, Popes Head Creek, Little Bull Run, Bull Run and the Occoquan River were based on the Virginia State Standard for *E. coli*. As detailed in Section 1.2, the *E. coli* standard states that the calendar month geometric-mean concentration shall not exceed 126 cfu/100 ml, and that a maximum single sample concentration of *E. coli* not exceed 235 cfu/100 ml. According to the guidelines put forth by the DEQ (DEQ, 2003) for modeling *E. coli* with HSPF, the model was set up to estimate loads of fecal *coliform*, and then the model output was converted to concentrations of *E. coli* with the following equation:

$$\log_2 (C_{ec}) = -0.0172 + 0.91905 * \log_2 (c_{fc})$$

Where  $C_{ec}$  is the concentration of *E. coli* in cfu/100 ml, and  $C_{fc}$  is the concentration of fecal *coliform* in cfu/100 ml.

The pollutant concentrations were simulated over the entire duration of a representative modeling period, and pollutant loads were adjusted until the standard was met. The development of the allocation scenarios was an iterative process requiring numerous runs where each run was followed by an assessment of source reduction against the water quality target. The following sections present the waste load allocation (WLA) and load allocations (LA) for the nine impaired segments.

### **5.3.1 Wasteload Allocation**

This Section outlines the wasteload allocations (WLA) for each impaired segment. It presents the existing and allocated loads for each permitted (VPDES and MS4) facility contributing to the impaired segment. The MS4 loads were calculated based on the MS4's specific acreage and the *E. coli* average loading rate (cfu/acre-yr) for the impaired segment. All the land-based *E. coli* loads were considered in the calculation of the MS4 loads, therefore the average land-based load reduction was assigned to the MS4. The MS4 loads are considered as a Waste Load Allocation (WLA) and are proportionally subtracted from the land-based load allocation (LA) presented in Section 5.4.

#### **5.3.1.1. Broad Run (Segment VAN-A19R-01)**

There are three facilities discharging bacteria to Broad Run (segment VAN-A19R-01). These facilities do not have a permit limit for bacteria. For this TMDL, the wasteload allocation for such facilities is to maintain discharge at the design flow limits and bacteria concentrations at the existing *E. coli* standard of 126 cfu/100mL. **Table 5-1** shows the loading from the permitted point source dischargers in Broad Run (segment VAN-A19R-01).

**Table 5-1: Broad Run (Segment VAN-A19R-01) Wasteload Allocation for *E. coli***

| Point Source | Existing Load (cfu/day) | Allocated Load (cfu/day) | Percent Reduction |
|--------------|-------------------------|--------------------------|-------------------|
| VA0050181    | 2.45E+11                | 2.45E+11                 | 0%                |
| VA0087700    | 3.04E+12                | 3.04E+12                 | 0%                |
| VA0088510    | 5.90E+10                | 5.90E+10                 | 0%                |
| <b>Total</b> | <b>3.26E+12</b>         | <b>3.26E+12</b>          | <b>0%</b>         |

Within Broad Run (segment VAN-A19R-01) there are four (4) MS4s permits requiring TMDL allocations. **Table 5-2** shows the waste load allocations for each MS4. The waste load allocations were based on each municipality's share of the contributing urbanized area of the impairment.

**Table 5-2: Broad Run (Segment VAN-A19R-01) MS4s Wasteload Allocation for *E. coli***

| MS4 Permit Holder             | Permit Number | Existing Load (cfu/yr) | Allocated Load (cfu/yr) | Percent Reduction |
|-------------------------------|---------------|------------------------|-------------------------|-------------------|
| City of Manassas              | VAR040063     | 6.01E+10               | 9.00E+09                | 85%               |
| Prince William County         | VAR088595     | 2.88E+12               | 4.32E+11                | 85%               |
| Prince William County Schools | VAR040026     | 6.79E+09               | 1.02E+09                | 85%               |
| VDOT Urban Area               | -             | 4.68E+09               | 7.01E+08                | 85%               |
| <b>Total</b>                  |               | <b>2.95E+12</b>        | <b>4.42E+11</b>         | <b>85%</b>        |

### 5.3.1.2. Broad Run (Segment VAN-A19R-02)

There are two facilities discharging bacteria to Broad Run (segment VAN-A19R-02). These facilities do not have a permit limit for bacteria. For this TMDL, the wasteload allocation for such facilities is to maintain discharge at the design flow limits and bacteria concentrations at the existing *E. coli* standard of 126 cfu/100mL. **Table 5-3** shows the loading from the permitted point source discharger in Broad Run (segment VAN-A19R-02). There are no MS4s permit holders within Broad Run (Segment VAN-A19R-02).

**Table 5-3: Broad Run (segment VAN-A19R-02) Waste load Allocation for *E. coli***

| Point Source | Existing Load (cfu/day) | Allocated Load (cfu/day) | Percent Reduction |
|--------------|-------------------------|--------------------------|-------------------|
| VA0029092    | 3.90E+09                | 3.90E+09                 | 0%                |
| VA0064157    | 1.60E+09                | 1.60E+09                 | 0%                |
| <b>Total</b> | <b>5.24E+09</b>         | <b>5.24E+09</b>          | <b>0%</b>         |

### 5.3.1.3. Broad Run (Segment VAN-A19R-05)

There are no industrial or municipal permitted facilities currently discharging into Broad Run (segment VAN-A19R-05). Following DEQ guidance, waste load allocations in watersheds without permitted facilities should not be shown as zero. Rather, they should be represented in the TMDL, expressed in terms of “less than” a number equal to or smaller than 1% of the Total Maximum Daily Load. This is reflected in **Table 5-17** showing the TMDL allocation plan for Broad Run (segment VAN-A19R-05). There are no MS4 permit holders within Broad Run (Segment VAN-A19R-05).

### 5.3.1.4. Bull Run (Segment VAN-A23R-01)

There are 7 permitted facilities in the Bull Run (segment VAN-A23R-01) watershed permitted to discharge bacteria. For this TMDL, the wasteload allocation for permitted facilities is to maintain discharge at the design flow limits and bacteria concentrations at their permitted levels of 126 cfu/100mL. **Table 5-4** shows the loading from the permitted point source dischargers in the watershed.

| Table 5-4: Bull Run (Segment VAN-A23R-01) Waste load Allocation for <i>E. coli</i> |                         |                          |                   |
|--|-------------------------|--------------------------|-------------------|
| Point Source   | Existing Load (cfu/day) | Allocated Load (cfu/day) | Percent Reduction |
| VA0024988  | 1.05E+13                | 1.05E+13                 | 0%                |
| VA0051683  | 1.27E+11                | 1.27E+11                 | 0%                |
| VA0051691  | 2.03E+10                | 2.03E+10                 | 0%                |
| VA0087858  | 5.58E+11                | 5.58E+11                 | 0%                |
| VA0087891  | 3.00E+09                | 3.00E+09                 | 0%                |
| VA0090441  | 9.51E+10                | 9.51E+10                 | 0%                |
| VA0091430  | 9.51E+10                | 9.51E+10                 | 0%                |
| <b>Total</b>   | <b>1.11E+13</b>         | <b>1.11E+13</b>          | <b>0%</b>         |

Within Bull Run (segment VAN-A23R-01) there are nine (9) MS4s permits requiring TMDL allocations. **Table 5-5** shows the waste load allocations for each MS4. The waste load allocations were based on each municipality’s share of the contributing urbanized area of the impairment.

**Table 5-5: Bull Run (Segment VAN-A23R-01) MS4s Wasteload Allocation for *E. coli***

| MS4 Permit Holder             | Permit Number | Existing Load (cfu/yr) | Allocated Load (cfu/yr) | Percent Reduction |
|-------------------------------|---------------|------------------------|-------------------------|-------------------|
| Fairfax County                | VA0088587     | 6.59E+11               | 6.59E+10                | 90%               |
| Loudon County                 | VA0000R       | 1.17E+11               | 1.17E+10                | 90%               |
| City of Manassas              | VAR040063     | 5.74E+10               | 5.74E+09                | 90%               |
| City of Manassas Park         | VAR0000A      | 3.16E+10               | 3.16E+09                | 90%               |
| Prince William County         | VA0088595     | 1.43E+11               | 1.43E+10                | 90%               |
| Fairfax County Public Schools | VAR040104     | 7.76E+08               | 7.76E+07                | 90%               |
| Prince William County Schools | VAR040100     | 2.51E+08               | 2.51E+07                | 90%               |
| Nova Manassas Campus          | -             | 2.11E+09               | 2.11E+08                | 90%               |
| VDOT Urban Area               | -             | 2.29E+10               | 2.29E+09                | 90%               |
| <b>Total</b>                  |               | <b>1.03E+12</b>        | <b>1.03E+11</b>         | <b>90%</b>        |

### 5.3.1.5. Kettle Run (Segment VAN-A19R-03)

There are no industrial or municipal permitted facilities currently discharging into Kettle Run (Segment VAN-A19R-03). Following DEQ guidance, waste load allocations in watersheds without permitted facilities should not be shown as zero. Rather, they should be represented in the TMDL, expressed in terms of “less than” a number equal to or smaller than 1% of the Total Maximum Daily Load. This is reflected in **Table 5-21** showing the TMDL allocation plan for Kettle Run (Segment VAN-A19R-03).

Within Kettle Run (segment VAN-A19R-03) there are two (2) MS4s permits requiring TMDL allocations. **Table 5-6** shows the waste load allocations for each MS4. The waste load allocations were based on each municipality’s share of the contributing urbanized area of the impairment.

**Table 5-6: Kettle Run (Segment VAN-A19R-03) MS4s Wasteload Allocation for *E. coli***

| MS4 Permit Holder | Permit Number | Existing Load (cfu/yr) | Allocated Load (cfu/yr) | Percent Reduction |
|-------------------|---------------|------------------------|-------------------------|-------------------|
| City of Warrenton | -             | 7.91E+10               | 3.96E+09                | 95%               |
| VDOT Urban Area   | -             | 1.78E+09               | 8.90E+07                | 95%               |
| <b>Total</b>      |               | <b>8.09E+10</b>        | <b>4.05E+09</b>         | <b>95%</b>        |

### 5.3.1.6. Little Bull Run (Segment VAN-A21R-01)

There are no industrial or municipal permitted facilities currently discharging into Little Bull Run (Segment VAN-A21R-01). Following DEQ guidance, waste load allocations in watersheds without permitted facilities should not be shown as zero. Rather, they should be represented in the TMDL, expressed in terms of “less than” a number equal to or smaller than 1% of the Total Maximum Daily Load. This is reflected in **Table 5-23** showing the TMDL allocation plan for Bull Run (Segment VAN-A21R-01). In addition, there are no MS4 permit holders within Broad Run (Segment VAN-A21R-01).

### 5.3.1.7. Occoquan River (Segment VAN-A20R-01)

There is only one (1) permitted facility in the Occoquan River (segment VAN-A20R-01) watershed permitted to discharge bacteria. For this TMDL, the wasteload allocation for this permitted facility is to maintain discharge at the design flow limits and bacteria concentrations at their permitted levels of 126 cfu/100mL. **Table 5-4** shows the loading from the permitted point source dischargers in the watershed.

| Table 5-7: Occoquan River (segment VAN-A20R-01) Waste load Allocation for <i>E. coli</i> |                         |                          |                   |
|--|-------------------------|--------------------------|-------------------|
| Point Source   | Existing Load (cfu/day) | Allocated Load (cfu/day) | Percent Reduction |
| VA0085901  | 1.43E+11                | 1.43E+11                 | 0%                |
| <b>Total</b>   | <b>1.43E+11</b>         | <b>1.43E+11</b>          | <b>0%</b>         |

Within the Occoquan River (segment VAN-A20R-01) there are two (4) MS4s permits requiring TMDL allocations. **Table 5-8** shows the waste load allocations for each MS4. The waste load allocations were based on each municipality’s share of the contributing urbanized area of the impairment.

| Table 5-8: Occoquan River (Segment VAN-A20R-01) MS4s Wasteload Allocation for <i>E. coli</i> |               |                        |                         |                   |
|--|---------------|------------------------|-------------------------|-------------------|
| MS4 Permit Holder  | Permit Number | Existing Load (cfu/yr) | Allocated Load (cfu/yr) | Percent Reduction |
| City of Manassas   | VAR040063     | 4.57E+11               | 2.29E+10                | 95%               |
| Prince William County  | VAR088595     | 2.62E+12               | 1.31E+11                | 95%               |
| Prince William County Schools  | VAR040100     | 9.00E+09               | 4.50E+08                | 95%               |
| VDOT Urban Area  | -             | 5.71E+10               | 2.86E+09                | 95%               |
| <b>Total</b>   |               | <b>3.15E+12</b>        | <b>1.57E+11</b>         | <b>95%</b>        |

### 5.3.1.8. Popes Head Creek (Segment VAN-A23R-02)

There are no industrial or municipal permitted facilities currently discharging into Popes Head (Segment VAN-A23R-02). Following DEQ guidance, waste load allocations in watersheds without permitted facilities should not be shown as zero. Rather, they should be represented in the TMDL, expressed in terms of “less than” a number equal to or smaller than 1% of the Total Maximum Daily Load. This is reflected in **Table 5-27** showing the TMDL allocation plan for Popes Head (Segment VAN-A23R-02).

Within Popes Head Creek (segment VAN-A23R-02) there are four (4) MS4s permits requiring TMDL allocations. **Table 5-9** shows the waste load allocations for each MS4. The waste load allocations were based on each municipality’s share of the contributing urbanized area of the impairment.

| Table 5-9: Popes Head Creek (Segment VAN-A23R-02) MS4s<br>Wasteload Allocation for <i>E. coli</i> |               |                        |                         |                   |
|---|---------------|------------------------|-------------------------|-------------------|
| MS4 Permit Holder   | Permit Number | Existing Load (cfu/yr) | Allocated Load (cfu/yr) | Percent Reduction |
| Fairfax County  | VAR088587     | 1.05E+13               | 5.23E+11                | 95%               |
| City of Fairfax   | VAR040064     | 1.57E+11               | 7.85E+09                | 95%               |
| Fairfax County Public School  | VAR040104     | 7.33E+10               | 3.66E+09                | 95%               |
| VDOT Urban Area   | -             | 2.36E+11               | 1.18E+10                | 95%               |
| <b>Total</b>  |               | <b>1.09E+13</b>        | <b>5.46E+11</b>         | 95%               |

### 5.3.1.9. South Run (Segment VAN-A19R-04)

There is only one (1) permitted facility in South Run (segment VAN-A19R-04) watershed permitted to discharge bacteria. For this TMDL, the wasteload allocation for this permitted facility is to maintain discharge at the design flow limits and bacteria concentrations at their permitted levels of 126 cfu/100mL. **Table 5-10** shows the loading from the permitted point source dischargers in the watershed.



| Table 5-10: South Run (segment VAN-A19R-02) Waste load Allocation for E. coli |                         |                          |                   |
|---|-------------------------|--------------------------|-------------------|
| Point Source  | Existing Load (cfu/day) | Allocated Load (cfu/day) | Percent Reduction |
| VA0020460   | 9.47E+08                | 7.40E+10                 | 0%                |
| <b>Total</b>  | <b>9.47E+08</b>         | <b>7.40E+10</b>          | <b>0%</b>         |

Within South Run (segment VAN-A19R-02) there are two (2) MS4s permits requiring TMDL allocations. **Table 5-11** shows the waste load allocations for each MS4. The waste load allocations were based on each municipality's share of the contributing urbanized area of the impairment.

| Table 5-11: South Run (Segment VAN-A19R-02) MS4s Wasteload Allocation for E. coli |               |                        |                         |                   |
|---|---------------|------------------------|-------------------------|-------------------|
| MS4 Permit Holder   | Permit Number | Existing Load (cfu/yr) | Allocated Load (cfu/yr) | Percent Reduction |
| City of Warrenton   | -             | 1.11E+11               | 5.53E+09                | 95%               |
| VDOT Urban Area   | -             | 2.72E+09               | 1.35E+08                | 95%               |
| <b>Total</b>  |               | <b>1.14E+11</b>        | <b>5.66E+09</b>         | <b>95%</b>        |

### 5.3.2 Load Allocations and TMDL Summaries

The reduction of loading from non-point sources, including livestock and wildlife direct deposition, is incorporated into the load allocation. A number of load allocation scenarios were developed in order to determine the final TMDL load allocation. Fecal *coliform* loading and instream fecal *coliform* concentrations were estimated for each potential scenario using the HSPF model for the hydrologic period of January 1995 to December 2004. **Table 5-12** shows the key load allocation scenarios that were implemented to arrive at the final TMDL allocations. It should be noted that these key scenarios are the one that have been implemented for all segments. However, additional scenarios were also implemented when deemed necessary to attain at the final TMDL. The following is a brief summary of the key scenarios:

- Scenario 0 is the existing load, no reduction of any of the sources.
- Scenario 1 represents elimination of human sources (septic systems and straight pipes).
- Scenario 2 represents the elimination of human sources (septic systems and straight pipes) as well as half the direct instream loading from livestock.

- Scenario 3 represents elimination of the human sources (septic systems and straight pipes) as well as the direct instream loading from livestock.
- Scenario 4 represents the direct instream loading from wildlife (all other sources are eliminated).

| <b>Table 5-12: TMDL Load Allocation Scenarios (%Reduction)</b> |                                  |                         |                          |                    |                        |
|--|----------------------------------|-------------------------|--------------------------|--------------------|------------------------|
| <b>Scenario</b>  | <b>Failed Septic &amp; Pipes</b> | <b>Direct Livestock</b> | <b>NPS (Agriculture)</b> | <b>NPS (Urban)</b> | <b>Direct Wildlife</b> |
| 0  | 0                                | 0                       | 0                        | 0                  | 0                      |
| 1  | 100                              | 0                       | 0                        | 0                  | 0                      |
| 2  | 100                              | 50                      | 0                        | 0                  | 0                      |
| 3  | 100                              | 100                     | 0                        | 0                  | 0                      |
| 4  | 100                              | 100                     | 100                      | 100                | 0                      |
| 5  | 100                              | 100                     | 0                        | 0                  | 50                     |
| 6  | 100                              | 100                     | 0                        | 0                  | 75                     |

The estimated load reductions for the different impaired segments derived from these allocation scenarios are presented separately in Appendix G. In addition, the percent of days the 126 cfu/100ml *E. coli* geometric mean water quality standard and the 235 cfu/100ml *E. coli* instantaneous water quality standard were violated under each scenario are presented.

## **5.4 TMDL Summary**

Based on the load allocation scenario analyses, the TMDL allocation plans are summarized below for each impaired segment.

### **5.4.1 Broad Run (VAN-A19R-01) Allocation Plan**

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Broad Run (Segment VAN-A19R-01) are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 85% reduction of bacteria loading from agricultural and urban non-point sources.

**Table 5-13** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

| Land Use/Source                   | Annual Average <i>E. coli</i> Loads<br>(cfu/yr) |            | Percent Reduction<br>(%) |
|-----------------------------------|---|------------|--------------------------|
|                                   | Existing  | Allocation |                          |
| Forest                            | 2.65E+09  | 3.98E+08   | 85%                      |
| Cropland                          | 8.50E+08  | 1.27E+08   | 85%                      |
| Pasture                           | 4.35E+09  | 6.51E+08   | 85%                      |
| Low Density Residential           | 2.01E+10  | 3.02E+09   | 85%                      |
| Commercial/Industrial             | 7.60E+09  | 1.14E+09   | 85%                      |
| Water/Wetland                     | 9.72E+07  | 1.46E+07   | 85%                      |
| Other Urban                       | 8.52E+08  | 1.28E+08   | 85%                      |
| High Density Residential          | 1.85E+10  | 2.76E+09   | 85%                      |
| Cattle - direct deposition        | 2.68E+12  | 0.00E+00   | 100%                     |
| Wildlife - direct deposition      | 3.88E+11  | 3.88E+11   | 0%                       |
| Failed Septic - direct deposition | 4.84E+09  | 0.00E+00   | 100%                     |
| Point Source                      | 3.26E+12  | 3.26E+12   | 0%                       |
| MS4s                              | 2.95E+12  | 4.42E+11   | 85%                      |
| Total loads /Overall reduction    | 9.34E+12  | 4.10E+12   | 56%                      |

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-1** and **Figure 5-2**. **Figure 5-1** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-2** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For Broad Run (Segment VAN-A19R-01), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Broad Run (VAN-A19R-01) is presented in **Table 5-14**.

| Point Sources<br>(WLA) | Non-point sources<br>(LA) | Margin of safety<br>(MOS) | TMDL     |
|------------------------|---------------------------|---------------------------|----------|
| 3.70E+12*              | 3.95E+11                  | IMPLICIT                  | 4.09E+12 |

(\*) includes the MS4 allocations

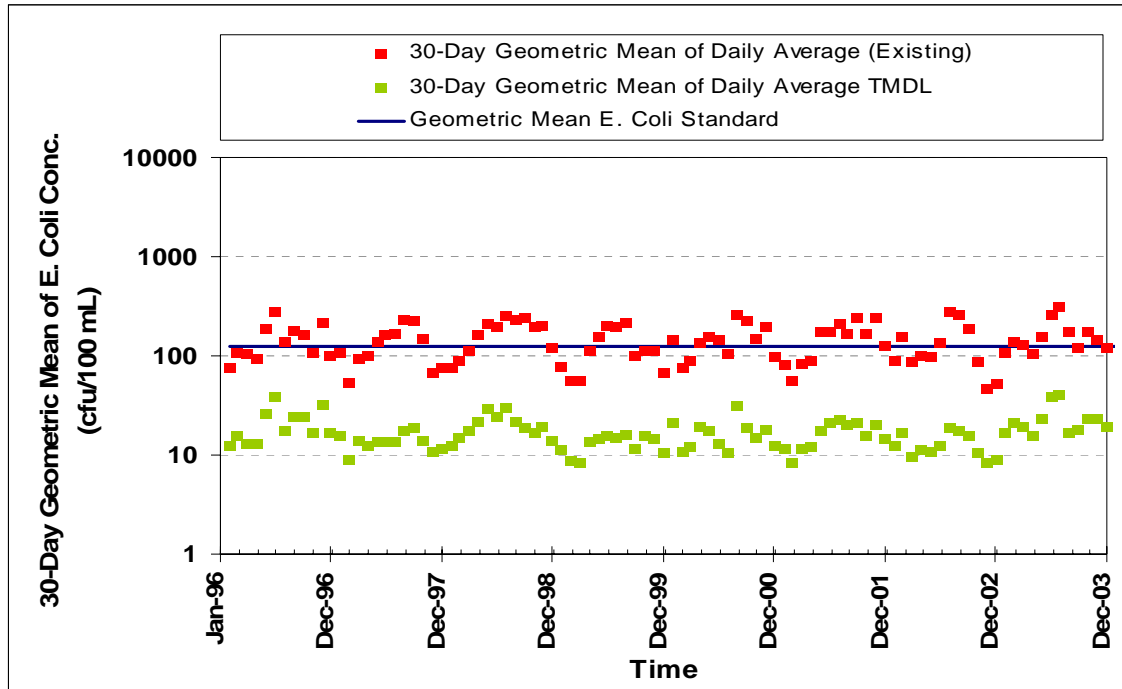


Figure 5-1: Broad Run (VAN-A19R-0) Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario

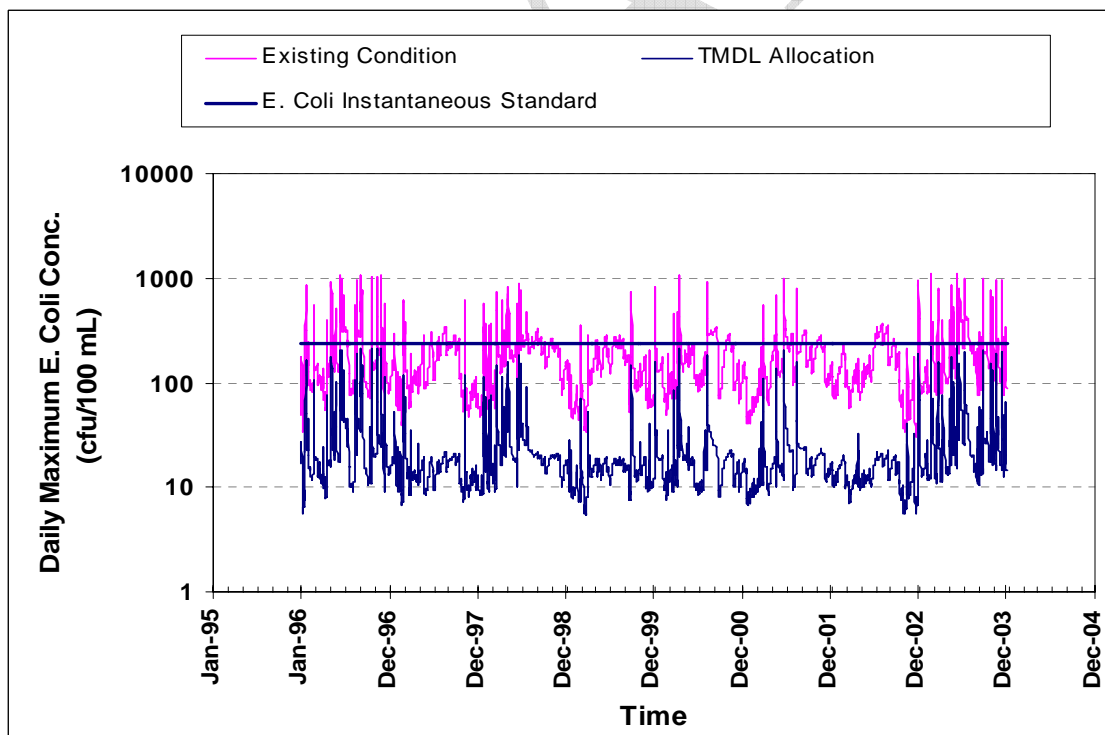


Figure 5-2: Broad Run (VAN-A19R-01) Instantaneous *E. coli* Loadings under Allocation Scenario

### 5.4.2 Broad Run (VAN-A19R-02) Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Broad Run (Segment VAN-A19R-02) are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 90% reduction of bacteria loading from agricultural and urban non-point sources.
- 60% reduction of the direct instream loading from wildlife.

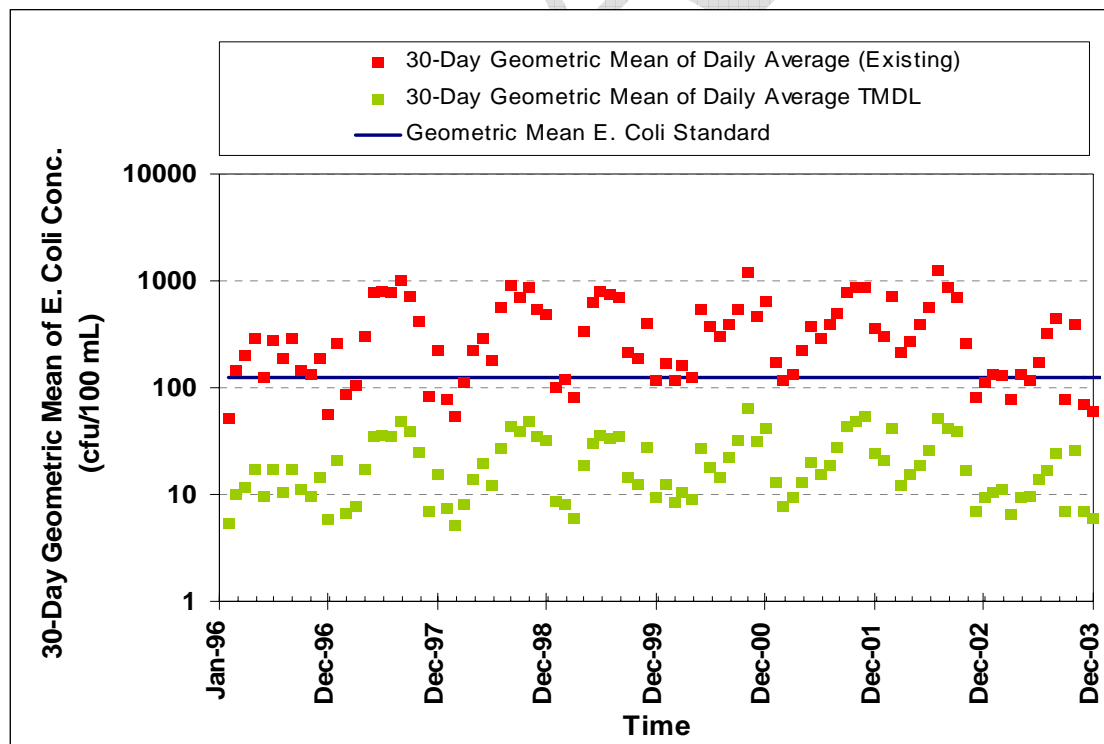
**Table 5-15** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

| <b>Table 5-15: Broad Run (VAN-A19R-02) Distribution of Annual Average <i>E. coli</i> Load under Existing Conditions and TMDL Allocation</b> |   |                   |                              |
|---|---|-------------------|------------------------------|
| <b>Land Use/Source</b>  | <b>Annual Average <i>E. coli</i> Loads (cfu/yr)</b> |                   | <b>Percent Reduction (%)</b> |
|   | <b>Existing</b>                                     | <b>Allocation</b> |                              |
| Forest  | 4.60E+10  | 4.60E+09          | 90                           |
| Cropland  | 1.24E+10  | 1.24E+09          | 90                           |
| Pasture   | 5.95E+10  | 5.95E+09          | 90                           |
| Low Density Residential   | 2.86E+11  | 2.86E+10          | 90                           |
| Commercial/Industrial   | 3.42E+10  | 3.42E+09          | 90                           |
| Water/Wetland   | 2.76E+08  | 2.76E+07          | 90                           |
| Other Urban   | 1.98E+09  | 1.98E+08          | 90                           |
| High Density Residential  | 0.00E+00  | 0.00E+00          | 90                           |
| Cattle - direct deposition  | 4.70E+11  | 0.00E+00          | 100                          |
| Wildlife - direct deposition  | 3.47E+11  | 1.39E+11          | 60                           |
| Failed Septic - direct deposition   | 5.12E+09  | 0.00E+00          | 100                          |
| Point Source  | 5.24E+09  | 5.24E+09          | 0.0                          |
| MS4s*   | 0.00E+00  | 0.00E+00          | N/A                          |
| <b>Total loads /Overall reduction</b>   | <b>1.26E+12</b>                                     | <b>1.88E+11</b>   | <b>85%</b>                   |

(\*) there are no MS4s in Broad Run (VAN-A19R-02)

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-3** and **Figure 5-4**. **Figure 5-3** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-4** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For Broad Run (Segment VAN-A19R-02), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Broad Run (VAN-A19R-02) is presented in **Table 5-16**.

| Table 5-16: Broad Run (VAN-A19R-02) TMDL Allocation Plan Loads (cfu/year) for <i>E. coli</i> |                        |                        |          |
|--|------------------------|------------------------|----------|
| Point Sources (WLA)  | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
| 5.24E+09   | 1.83E+11               | IMPLICIT               | 1.88E+11 |



**Figure 5-3: Broad Run (VAN-A19R-02) Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario**

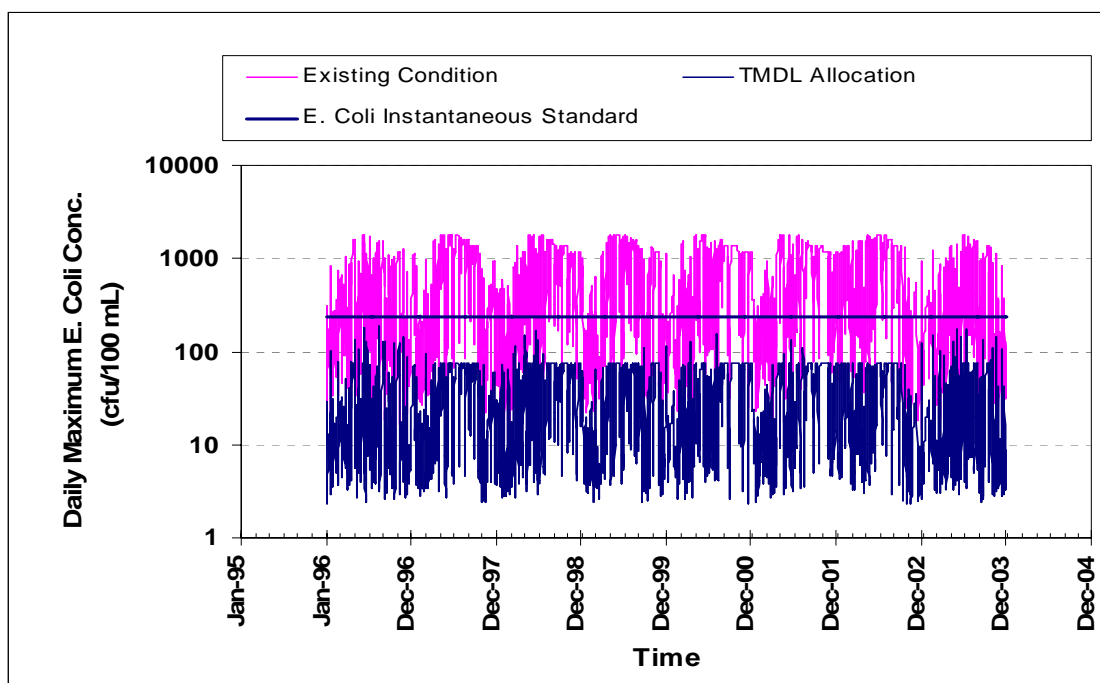


Figure 5-4: Broad Run (VAN-A19R-02) Instantaneous *E. coli* Loadings under Allocation Scenario

### 5.4.3 Broad Run (VAN-A19R-05) Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Broad Run (Segment VAN-A19R-05) are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 95% reduction of bacteria loading from agricultural and urban non-point sources.
- 80% reduction of the direct instream loading from wildlife.

Table 5-17 shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

**Table 5-17: Broad Run (VAN-A19R-05) Distribution of Annual Average *E. coli* Load under Existing Conditions and TMDL Allocation**

| Land Use/Source                       | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|---------------------------------------|--|-----------------|-----------------------|
|                                       | Existing                                     | Allocation      |                       |
| Forest                                | 4.23E+10                                     | 2.11E+09        | 95                    |
| Cropland                              | 1.75E+10                                     | 8.74E+08        | 95                    |
| Pasture                               | 1.08E+11                                     | 5.41E+09        | 95                    |
| Low Density Residential               | 1.12E+11                                     | 5.59E+09        | 95                    |
| Commercial/Industrial                 | 4.54E+10                                     | 2.27E+09        | 95                    |
| Water/Wetland                         | 5.31E+07                                     | 2.66E+06        | 95                    |
| Other Urban                           | 0.00E+00                                     | 0.00E+00        | 95                    |
| High Density Residential              | 0.00E+00                                     | 0.00E+00        | 95                    |
| Cattle - direct deposition            | 3.01E+11                                     | 0.00E+00        | 100                   |
| Wildlife - direct deposition          | 3.74E+11                                     | 7.49E+10        | 80                    |
| Failed Septic - direct deposition     | 1.93E+09                                     | 0.00E+00        | 100                   |
| Point Source <sup>#</sup>             | 0.00E+00                                     | 9.11E+08        | N/A                   |
| MS4s*                                 | 0.00E+00                                     | 0.00E+00        | -                     |
| <b>Total loads /Overall reduction</b> | <b>1.00E+12</b>                              | <b>9.11E+10</b> | <b>91%</b>            |

(\*) there are no MS4s in Broad Run (VAN-A19R-05)

(#) there are no point source dischargers; the WLA is 1 percent of the total TMDL

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-5** and **Figure 5-6**. **Figure 5-5** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-6** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For Broad Run (Segment VAN-A19R-05), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Broad Run (VAN-A19R-05) Creek is presented in **Table 5-18**.

**Table 5-18: Broad Run (VAN-A19R-05) TMDL Allocation Plan Loads (cfu/year) for *E. coli***

| Point Sources (WLA) | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
|---------------------|------------------------|------------------------|----------|
| 9.11E+08            | 9.02E+10               | IMPLICIT               | 9.11E+10 |



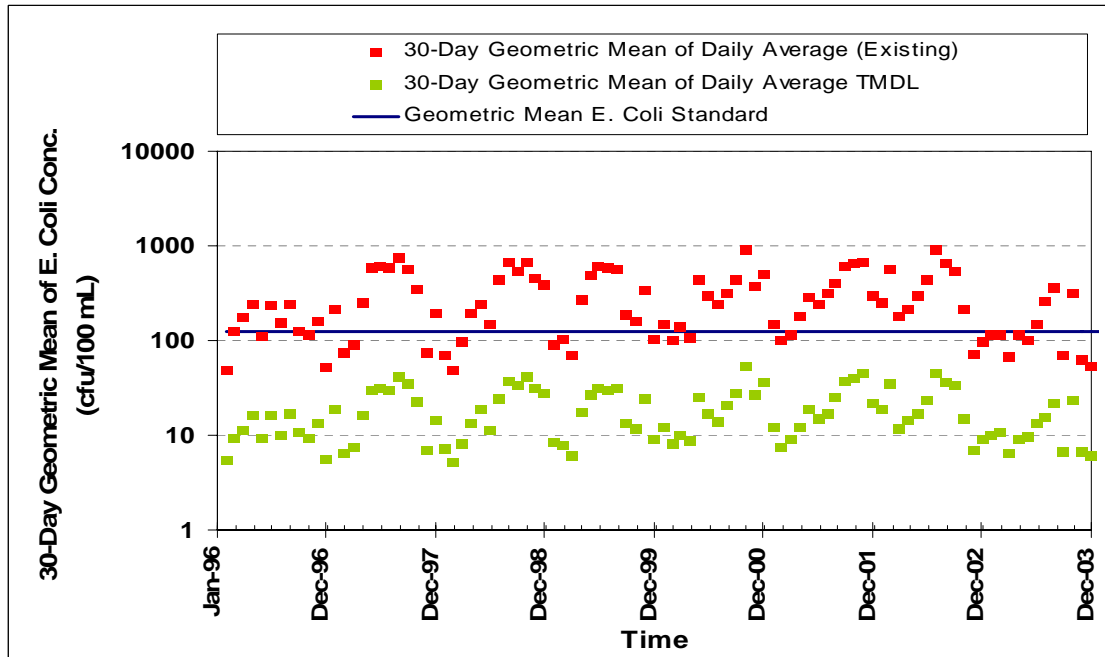


Figure 5-5: Broad Run (VAN-A19R-05) Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario

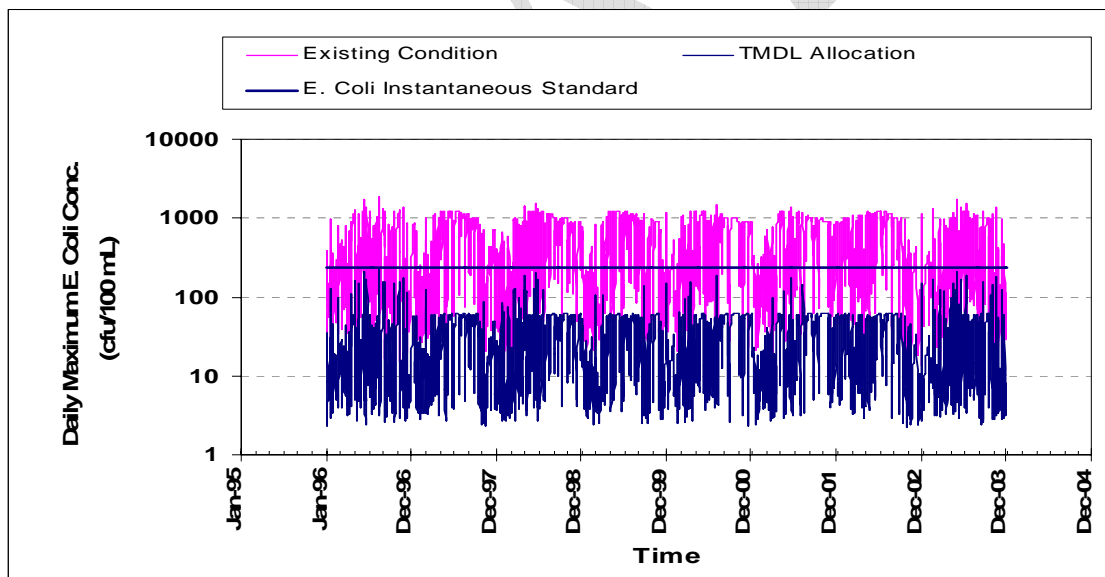


Figure 5-6: Broad Run (VAN-A19R-05) Instantaneous *E. coli* Loadings under Allocation Scenario

#### 5.4.4 Bull Run Segment VAN-A23R-01 Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Bull Run are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 90% reduction of bacteria loading from agricultural and urban non-point sources.

**Table 5-19** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

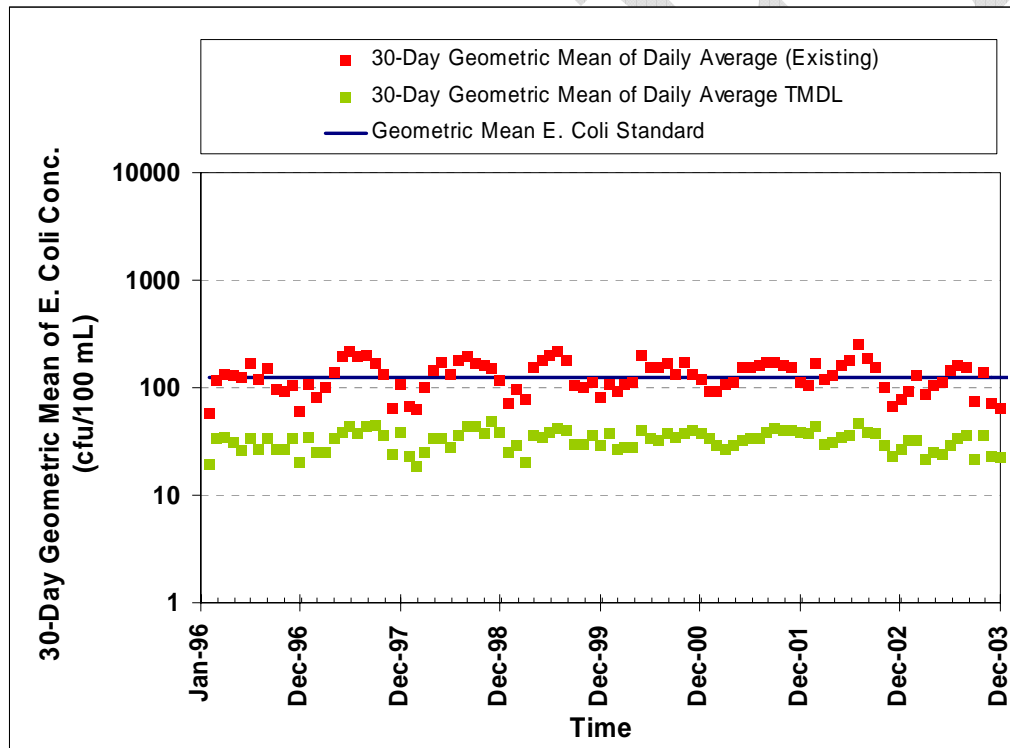
| Land Use/Source                       | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|---------------------------------------|--|-----------------|-----------------------|
|                                       | Existing                                     | Allocation      |                       |
| Forest                                | 1.42E+10                                     | 1.42E+09        | 90.0%                 |
| Cropland                              | 7.95E+07                                     | 7.95E+06        | 90.0%                 |
| Pasture                               | 3.19E+09                                     | 3.19E+08        | 90.0%                 |
| Low Density Residential               | 5.83E+11                                     | 5.83E+10        | 90.0%                 |
| Commercial/Industrial                 | 2.57E+10                                     | 2.57E+09        | 90.0%                 |
| Water/Wetland                         | 6.50E+08                                     | 6.50E+07        | 90.0%                 |
| Other Urban                           | 8.98E+09                                     | 8.98E+08        | 90.0%                 |
| High Density Residential              | 4.66E+11                                     | 4.66E+10        | 90.0%                 |
| Cattle - direct deposition            | 8.93E+12                                     | 0.00E+00        | 100.0%                |
| Wildlife - direct deposition          | 4.88E+12                                     | 4.88E+12        | 0.0%                  |
| Failed Septic - direct deposition     | 2.91E+10                                     | 0.00E+00        | 100.0%                |
| Point Source                          | 1.11E+13                                     | 1.11E+13        | 0.0%                  |
| MS4s                                  | 1.03E+12                                     | 1.03E+11        | 90.0%                 |
| <b>Total loads /Overall reduction</b> | <b>2.71E+13</b>                              | <b>1.62E+13</b> | <b>40.2%</b>          |

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-7** and **Figure 5-8**. **Figure 5-7** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-8** shows the instantaneous *E. coli* loadings also under the allocations

as well as the loading under existing conditions. For Bull Run (Segment VAN-A23R-01), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Bull Run is presented in **Table 5-20**.

| Table 5-20: Bull Run Segment VAN-A23R-01 TMDL Allocation Plan Loads (cfu/year) for <i>E. coli</i> |                        |                        |          |
|---|------------------------|------------------------|----------|
| Point Sources (WLA)   | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
| 1.12E+13*   | 4.99E+12               | IMPLICIT               | 1.62E+13 |

(\*) includes the MS4 allocations



**Figure 5-7: Bull Run Segment VAN-A23R-01 Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario**

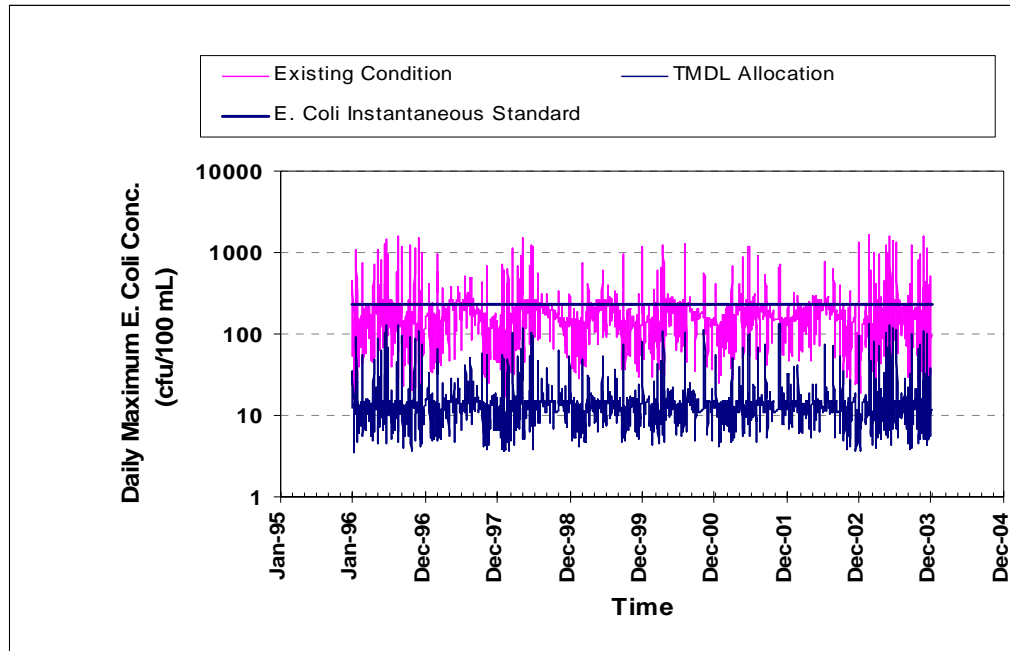


Figure 5-8 Bull Run Segment VAN-A23R-01 Instantaneous *E. coli* Loadings under Allocation Scenario

#### 5.4.5 Kettle Run Segment VAN-A19R-03 Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Kettle Run are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 95% reduction of bacteria loading from agricultural and urban non-point sources.
- 50% reduction of the direct instream loading from wildlife.

**Table 5-21** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

**Table 5-21: Kettle Run VAN-A19R-03 Distribution of Annual Average *E. coli* Load under Existing Conditions and TMDL Allocation (Excluding MS4s from the Land-based Loads)**

| Land Use/Source                       | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|---------------------------------------|--|-----------------|-----------------------|
|                                       | Existing                                     | Allocation      |                       |
| Forest                                | 3.18E+10                                     | 1.59E+09        | 95.0%                 |
| Cropland                              | 3.07E+10                                     | 1.54E+09        | 95.0%                 |
| Pasture                               | 4.81E+10                                     | 2.40E+09        | 95.0%                 |
| Low Density Residential               | 4.98E+11                                     | 2.49E+10        | 95.0%                 |
| Commercial/Industrial                 | 2.37E+10                                     | 1.19E+09        | 95.0%                 |
| Water/Wetland                         | 4.79E+08                                     | 2.40E+07        | 95.0%                 |
| Other Urban                           | 8.85E+09                                     | 4.43E+08        | 95.0%                 |
| High Density Residential              | 3.06E+10                                     | 1.54E+09        | 95.0%                 |
| Cattle - direct deposition            | 6.84E+11                                     | 0.00E+00        | 100.0%                |
| Wildlife - direct deposition          | 1.25E+11                                     | 6.27E+10        | 49.8%                 |
| Failed Septic - direct deposition     | 4.74E+09                                     | 0.00E+00        | 100.0%                |
| Point Source <sup>#</sup>             | 0.00E+00                                     | 1.00E+09        | NA                    |
| MS4s                                  | 8.09E+10                                     | 4.05E+09        | 95.0%                 |
| <b>Total loads /Overall reduction</b> | <b>1.57E+12</b>                              | <b>1.00E+11</b> | <b>93.6%</b>          |

(#) there are no point source dischargers; the WLA is 1 percent of the total TMDL

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-9** and **Figure 5-10**. **Figure 5-9** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-10** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For Kettle Run (Segment VAN-A19R-03), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Kettle Run is presented in **Table 5-22**.

**Table 5-22: Kettle Run Segment VAN-A19R-03 TMDL Allocation Plan Loads (cfu/year) for *E. coli***

| Point Sources (WLA) | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
|---------------------|------------------------|------------------------|----------|
| 5.05E+09*           | 9.495E+10              | IMPLICIT               | 1.00E+11 |

(\*) includes the MS4 allocations

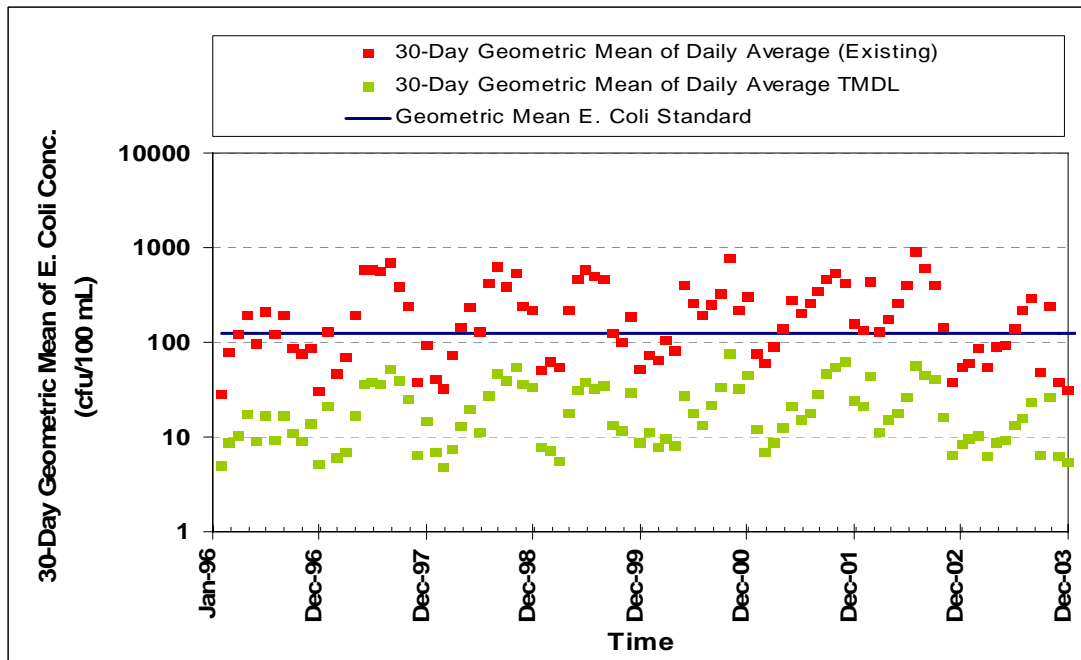


Figure 5-9: Kettle Run Segment VAN-A19R-03 Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario

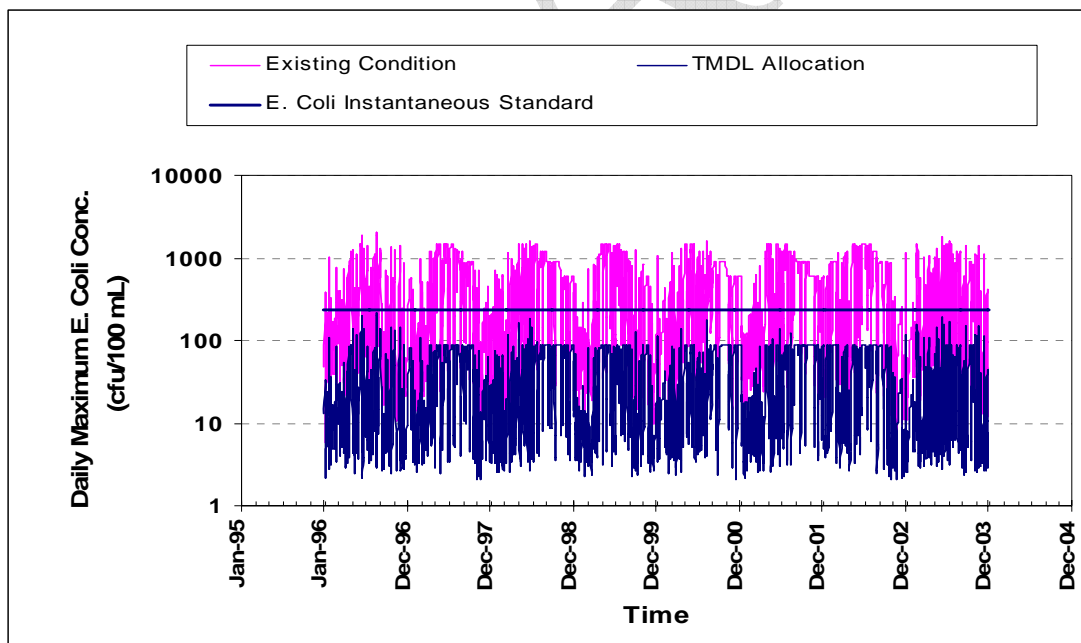


Figure 5-10: Kettle Run Segment VAN-A19R-03 Instantaneous *E. coli* Loadings under Allocation Scenario

#### 5.4.6 Little Bull Run Segment VAN-A21R-01 Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Little Bull Run are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 90% reduction of bacteria loading from agricultural and urban non-point sources.

**Table 5-23** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

| Land Use/Source                       | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|---------------------------------------|--|-----------------|-----------------------|
|                                       | Existing                                     | Allocation      |                       |
| Forest                                | 4.44E+10                                     | 4.44E+09        | 90%                   |
| Cropland                              | 9.87E+09                                     | 9.87E+08        | 90%                   |
| Pasture                               | 4.54E+10                                     | 4.54E+09        | 90%                   |
| Low Density Residential               | 2.45E+11                                     | 2.45E+10        | 90%                   |
| Commercial/Industrial                 | 5.37E+10                                     | 5.37E+09        | 90%                   |
| Water/Wetland                         | 4.33E+08                                     | 4.33E+07        | 90%                   |
| Other Urban                           | 2.63E+10                                     | 2.63E+09        | 90%                   |
| High Density Residential              | 2.72E+11                                     | 2.72E+10        | 90%                   |
| Cattle - direct deposition            | 6.00E+11                                     | 0.00E+00        | 100%                  |
| Wildlife - direct deposition          | 1.49E+11                                     | 1.49E+11        | 0%                    |
| Failed Septic - direct deposition     | 1.38E+09                                     | 0.00E+00        | 100%                  |
| Point Sources <sup>#</sup>            | 0.00E+00                                     | 2.18E+09        | 0%                    |
| MS4s*                                 | 0.00E+00                                     | 0.00E+00        | 0%                    |
| <b>Total loads /Overall reduction</b> | <b>1.45E+12</b>                              | <b>2.18E+11</b> | <b>85%</b>            |

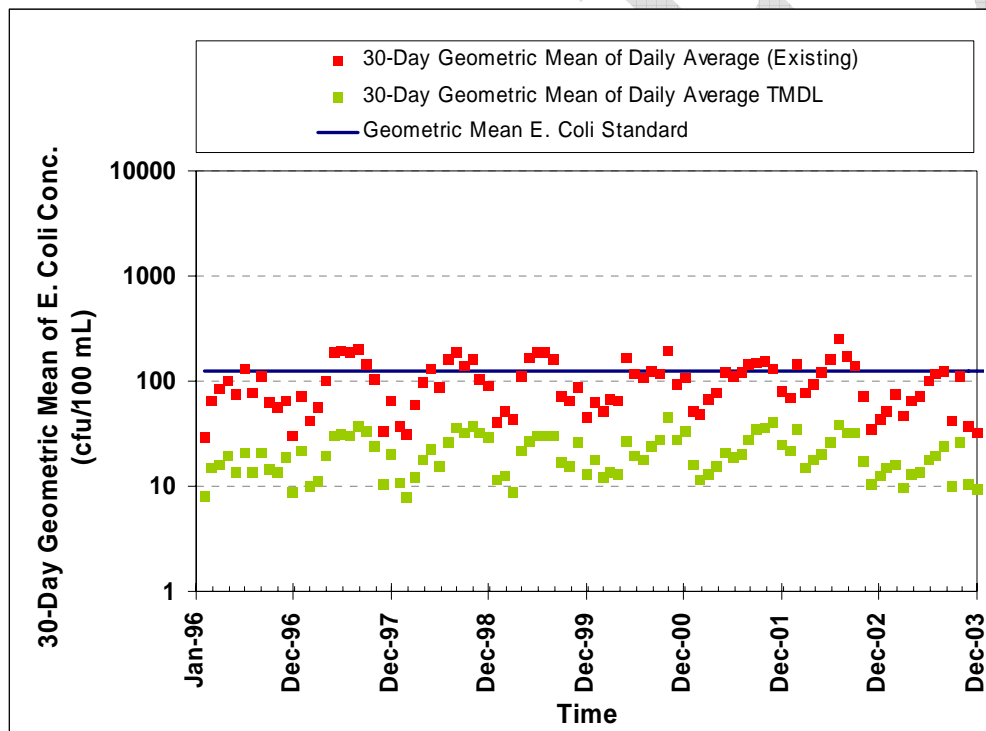
(\*) there are no MS4s in Broad Run (VAN-A19R-05)

(#) there are no point source dischargers; the WLA is 1 percent of the total TMDL

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-11** and **Figure 5-12**. **Figure 5-11** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-12** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For Little Bull Run

(Segment VAN-A21R-01), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Little Bull Run is presented in **Table 5-24**.

| Table 5-24: Little Bull Run Segment VAN-A21R-01 TMDL Allocation Plan Loads (cfu/year) for <i>E. coli</i> |                        |                        |          |
|--|------------------------|------------------------|----------|
| Point Sources (WLA)  | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
| 2.18E+09   | 2.16E+11               | IMPLICIT               | 2.18E+11 |



**Figure 5-11: Little Bull Run Segment VAN-A21R-01 Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario**



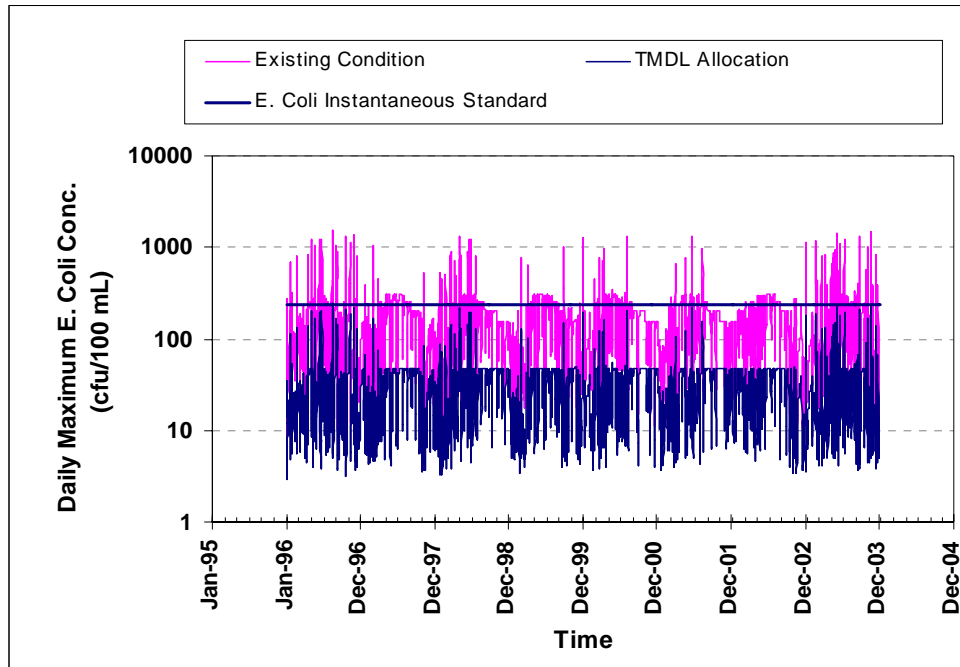


Figure 5-12: Little Bull Run Segment VAN-A21R-01 Instantaneous *E. coli* Loadings under Allocation Scenario

#### 5.4.7 Occoquan River Segment VAN-A20R-01 Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for the Occoquan River are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 95% reduction of bacteria loading from agricultural and urban non-point sources.

**Table 5-25** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

**Table 5-25: Occoquan River VAN-A20R-01 Distribution of Annual Average *E. Coli* Load under Existing Conditions and TMDL Allocation (Excluding MS4s from the Land-based Loads)**

| Land Use/Source                       | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|---------------------------------------|--|-----------------|-----------------------|
|                                       | Existing                                     | Allocation      |                       |
| Forest                                | 3.71E+09                                     | 1.89E+08        | 95%                   |
| Cropland                              | 7.62E+08                                     | 3.73E+07        | 95%                   |
| Pasture                               | 1.53E+09                                     | 7.41E+07        | 95%                   |
| Low Density Residential               | 1.26E+11                                     | 6.15E+09        | 95%                   |
| Commercial/Industrial                 | 1.72E+10                                     | 8.54E+08        | 95%                   |
| Water/Wetland                         | 1.15E+08                                     | 5.81E+06        | 95%                   |
| Other Urban                           | 2.87E+09                                     | 1.47E+08        | 95%                   |
| High Density Residential              | 1.15E+11                                     | 5.91E+09        | 95%                   |
| Cattle - direct deposition            | 6.91E+10                                     | 0.00E+00        | 100%                  |
| Wildlife - direct deposition          | 3.56E+11                                     | 3.56E+11        | 0%                    |
| Failed Septic - direct deposition     | 5.26E+09                                     | 0.00E+00        | 100%                  |
| Point Source                          | 1.43E+11                                     | 1.43E+11        | 0%                    |
| MS4s                                  | 3.15E+12                                     | 1.57E+11        | 95%                   |
| <b>Total loads /Overall reduction</b> | <b>3.99E+12</b>                              | <b>6.70E+11</b> | <b>83%</b>            |

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-13** and **Figure 5-14**. **Figure 5-13** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-14** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For the Occoquan River (Segment VAN-A20R-01), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for the Occoquan River is presented in **Table 5-26**.

**Table 5-26: Occoquan River Segment VAN-A20R-01 TMDL Allocation Plan Loads (cfu/year) for *E. coli***

| Point Sources (WLA) | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
|---------------------|------------------------|------------------------|----------|
| 3.00E+11*           | 3.70E+11               | IMPLICIT               | 6.70E+11 |

(\*) includes the MS4 allocations

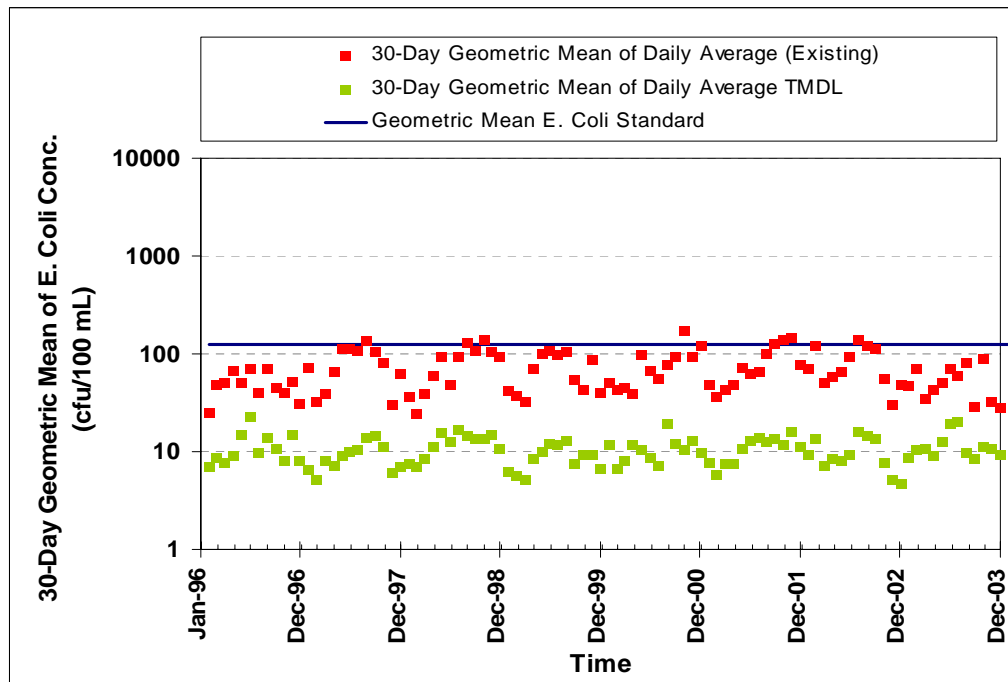


Figure 5-13: Occoquan River Segment VAN-A20R-01 Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario

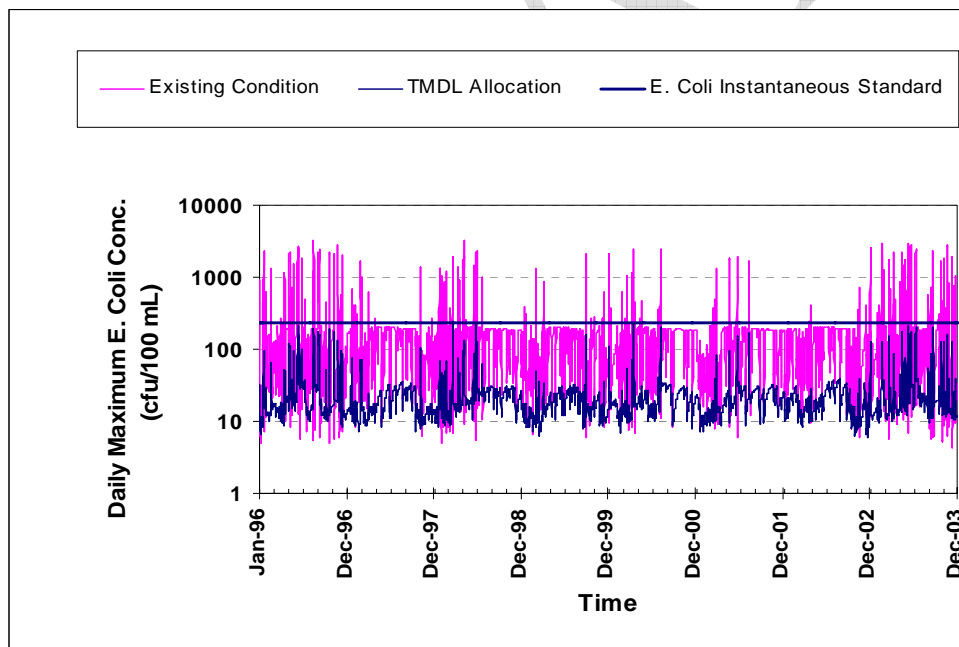


Figure 5-14 Occoquan River Segment VAN-A20R-01 Instantaneous *E. coli* Loadings under Allocation Scenario

#### 5.4.8 Popes Head Creek Segment VAN-A23R-02 Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for Popes Head Creek are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 95% reduction of bacteria loading from agricultural and urban non-point sources.
- 48% reduction of the direct instream loading from wildlife.

**Table 5-27** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

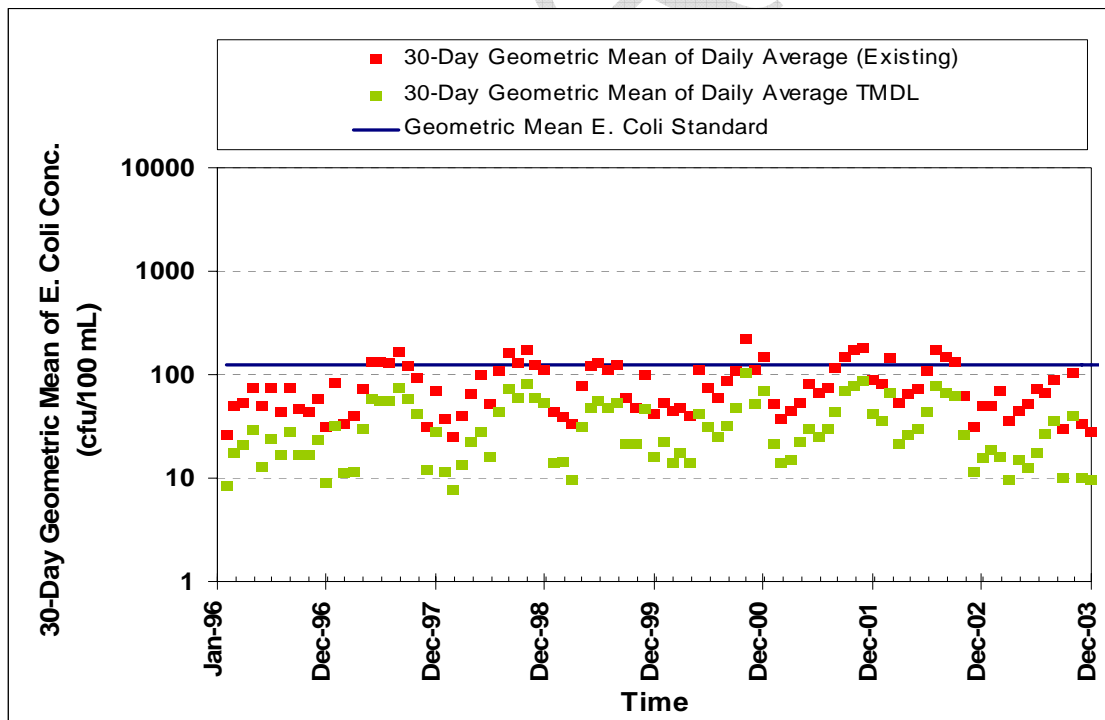
| Table 5-27: Popes Head Creek VAN-A23R-02 Distribution of Annual Average <i>E. Coli</i> Load under Existing Conditions and TMDL Allocation (Excluding MS4s from the Land-based Loads) |  |                 |                       |
|--|--|-----------------|-----------------------|
| Land Use/Source  | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|  | Existing                                     | Allocation      |                       |
| Forest   | 6.90E+09                                     | 3.69E+08        | 95%                   |
| Cropland   | 2.37E+09                                     | 1.20E+08        | 95%                   |
| Pasture  | 7.80E+09                                     | 3.74E+08        | 95%                   |
| Low Density Residential  | 9.32E+10                                     | 4.71E+09        | 95%                   |
| Commercial/Industrial  | 5.87E+10                                     | 3.17E+09        | 95%                   |
| Water/Wetland  | 3.66E+08                                     | 1.90E+07        | 95%                   |
| Other Urban  | 8.29E+09                                     | 4.39E+08        | 95%                   |
| High Density Residential   | 3.35E+11                                     | 1.64E+10        | 95%                   |
| Cattle - direct deposition   | 3.46E+10                                     | 0.00E+00        | 100%                  |
| Wildlife - direct deposition   | 2.45E+11                                     | 1.28E+11        | 48%                   |
| Failed Septic - direct deposition  | 2.32E+09                                     | 0.00E+00        | 100%                  |
| Point Source <sup>#</sup>  | 0.00E+00                                     | 7.00E+09        | NA                    |
| MS4s   | 1.09E+13                                     | 5.46E+11        | 95%                   |
| <b>Total loads /Overall reduction</b>  | <b>1.17E+13</b>                              | <b>7.00E+11</b> | <b>94.4%</b>          |

(#) there are no point source dischargers; the WLA is 1 percent of the total TMDL

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-15** and **Figure 5-16**. **Figure 5-15** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-16** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For Popes Head (Segment VAN-A23R-02), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for Popes Head Creek is presented in **Table 5-28**.

| Table 5-28: Popes Head Creek Segment VAN-A23R-02 TMDL Allocation Plan Loads (cfu/year) for <i>E. coli</i> |                        |                        |          |
|---|------------------------|------------------------|----------|
| Point Sources (WLA)   | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
| 5.53E+11*   | 1.47E+11               | IMPLICIT               | 7.00E+11 |

(\*) includes the MS4 allocations



**Figure 5-15: Popes Head Creek Segment VAN-A23R-02 Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario**

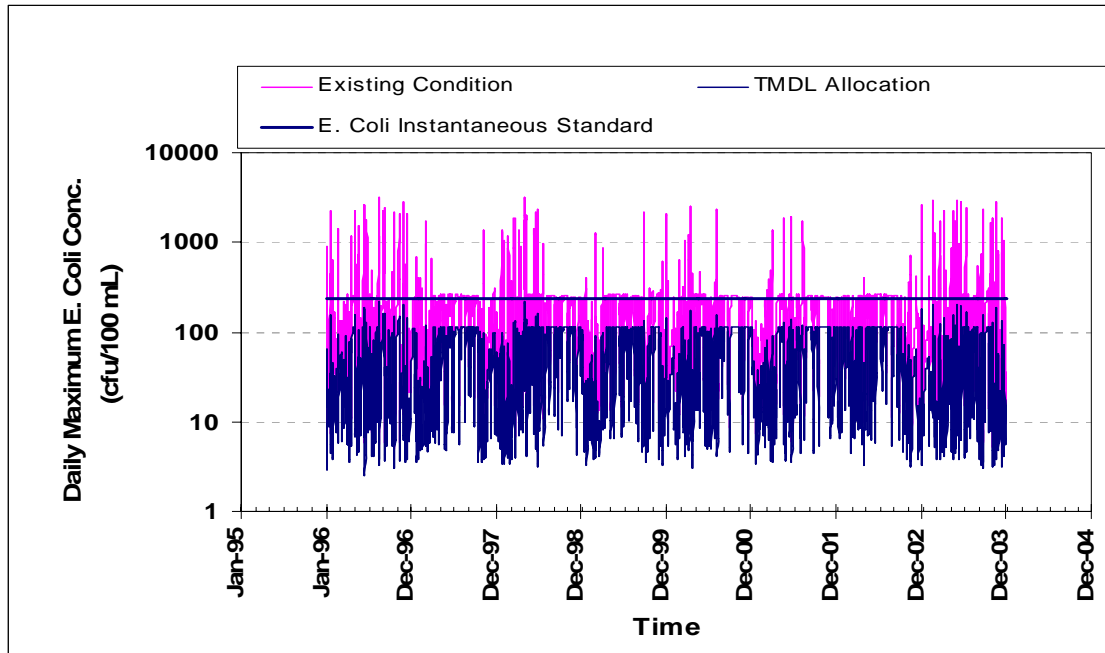


Figure 5-16: Popes Head Creek Segment VAN-A23R-02 Instantaneous *E. coli* Loadings under Allocation Scenario

#### 5.4.9 South Run Segment VAN-A19R-04 Allocation Plan

The requirements to meet 30-day *E. coli* geometric mean water quality standard of 126 cfu/100 ml and the instantaneous water quality standard of 235 cfu/100ml for South Run are:

- 100 % reduction of the human sources (failed septic systems and straight pipes).
- 100 % reduction of the direct instream loading from livestock.
- 95% reduction of bacteria loading from agricultural and urban non-point sources.
- 50% reduction of the direct instream loading from wildlife.

**Table 5-29** shows the distribution of the annual average *E. coli* load under existing conditions and under the TMDL allocation, by land use and source. The monthly distribution of these loads is presented in Appendix H.

**Table 5-29: South Run VAN-A19R-04 Distribution of Annual Average *E. coli* Load under Existing Conditions and TMDL Allocation (Excluding MS4s from the Land-based Loads)**

| Land Use/Source                       | Annual Average <i>E. coli</i> Loads (cfu/yr) |                 | Percent Reduction (%) |
|---------------------------------------|--|-----------------|-----------------------|
|                                       | Existing                                     | Allocation      |                       |
| Forest                                | 7.02E+09                                     | 3.53E+08        | 95%                   |
| Cropland                              | 4.87E+08                                     | 2.44E+07        | 95%                   |
| Pasture                               | 1.32E+10                                     | 6.59E+08        | 95%                   |
| Low Density Residential               | 2.14E+11                                     | 1.07E+10        | 95%                   |
| Commercial/Industrial                 | 1.29E+10                                     | 6.46E+08        | 95%                   |
| Water/Wetland                         | 4.67E+08                                     | 2.33E+07        | 95%                   |
| Other Urban                           | 3.71E+08                                     | 1.86E+07        | 95%                   |
| High Density Residential              | 2.20E+09                                     | 1.09E+08        | 95%                   |
| Cattle - direct deposition            | 1.03E+11                                     | 0.00E+00        | 100%                  |
| Wildlife - direct deposition          | 6.39E+10                                     | 3.19E+10        | 50%                   |
| Failed Septic - direct deposition     | 2.78E+09                                     | 0.00E+00        | 100%                  |
| Point Source                          | 7.40E+10                                     | 7.40E+10        | 0%                    |
| MS4s                                  | 1.14E+11                                     | 5.66E+09        | 95%                   |
| <b>Total loads /Overall reduction</b> | <b>6.08E+11</b>                              | <b>1.24E+11</b> | <b>80%</b>            |

The resulting geometric mean and instantaneous *E. coli* concentrations under the TMDL allocation plan are presented in **Figure 5-17** and **Figure 5-18**. **Figure 5-17** shows the 30-day geometric mean *E. coli* loading, as well as geometric mean loading under existing conditions. **Figure 5-18** shows the instantaneous *E. coli* loadings also under the allocations as well as the loading under existing conditions. For South Run (Segment VAN-A19R-04), the allocation results in bacteria concentrations that are consistently below both the geometric mean and instantaneous standards for *E. coli*. A summary of the TMDL allocation plan loads for South Run is presented in **Table 5-30**.

**Table 5-30: South Run Segment VAN-A19R-04 TMDL Allocation Plan Loads (cfu/year) for *E. coli***

| Point Sources (WLA) | Non-point sources (LA) | Margin of safety (MOS) | TMDL     |
|---------------------|------------------------|------------------------|----------|
| 7.96E+10*           | 4.45E+10               | IMPLICIT               | 1.24E+11 |

(\*) include the MS4 allocations

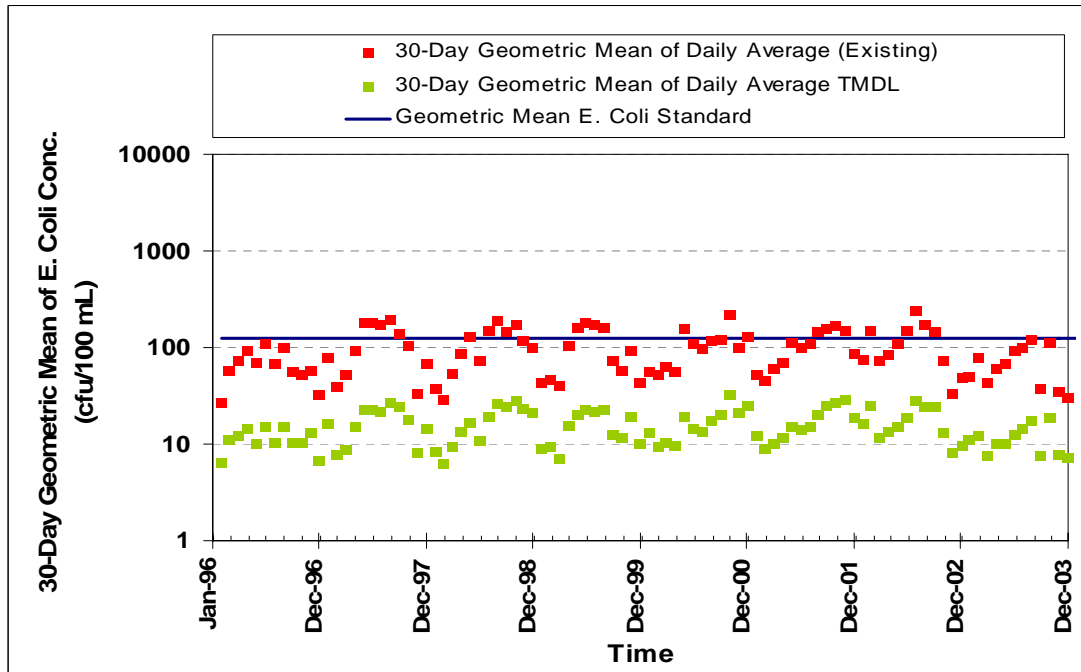


Figure 5-17: South Run (Segment VAN-A19R-04) Geometric Mean *E. coli* Loadings under Existing Conditions and Allocation Scenario

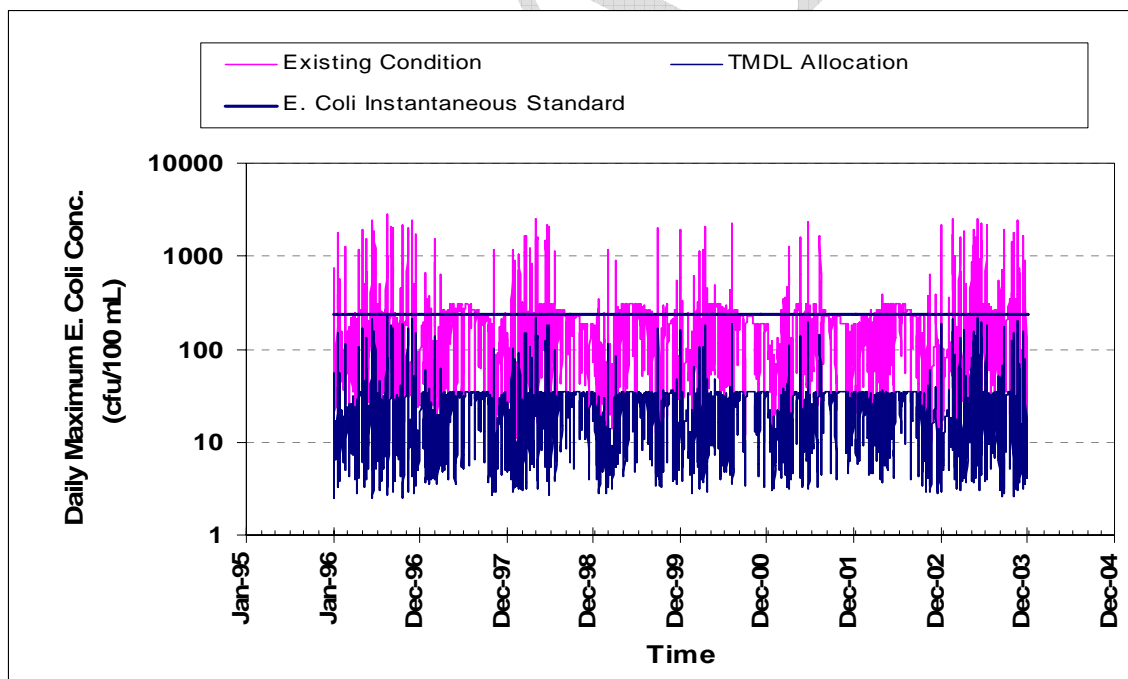


Figure 5-18: South Run (Segment VAN-A19R-04) Instantaneous *E. coli* Loadings under Allocation Scenario